Columbus Climate Adaptation Plan

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ENR/AEDECON 4567: Assessing Sustainability
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April 17, 2014

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Executive summary

As climate change continues to be a politically 'hot' topic, some cities are reacting by creating climate adaptation plans to improve city infrastructure and elements to be more adaptable when facing the effects of a changing climate. Many cities, such as Boston, Philadelphia, and Chicago have experienced large-scale climate events (weather enhanced or created by changing climate conditions) such as Hurricane Sandy and this has led to unanimous support for undertaking adaptation efforts to reduce cities' vulnerabilities to these climate events. However, most climate action is witnessed in coastal cities.

The purpose of this research is to discern the importance of a climate adaptation plan for the City of Columbus. Specifically, our goals were to: research climate impacts and successful actions in large cities, to evaluate climate activity in Ohio including economic impacts, to determine what work has already been done to address this potential issue, and to analyze and calculate possible options and recommendations for Columbus. With these goals in mind, we set the objectives to clearly determine the possibility of an action plan in Columbus, to discern the best practices of other cities and gather insight to produce successful results from those working on climate action in large cities, and to determine next steps for Columbus regarding the creation of a climate adaptation plan. Since Columbus is an inland city and the effects of Climate Change are not always obvious, it is important to take action before the effects become obvious and cause serious economic, social, and environmental damage.

Our research regarding other cities and their climate action revealed that once climate change is identified as a threat by the public and local government, the support for a climate adaptation plan is more than sufficient. Especially when a large climate event, such as Hurricane Sandy, drastically affects a city, the public recognizes the value in pursuing such a plan due to

the experience of recovering from a disaster. Another important piece of information gained from research into other cities is the need for consistent language and leadership. If climate adaptation is the desired effort, then the local government should not shy away from using terms such as 'climate change.' Additionally, mitigating climate vulnerabilities is a complex issue as the various elements of a city (transportation, building, storm systems, etc.) each have their own vulnerabilities. For a climate adaptation plan to be successful, the local government must work with all departments to identify climate vulnerabilities and determine strategies to improve resilience. Research into Columbus's climate vulnerability reveals a history of climate events and significant impacts that have resulted in hundreds of millions of dollars in damages. This fact, along with the threat of increased climate event frequency, supports the need for a climate adaptation plan in Columbus. Finally, data from active climate adaptation plans demonstrate that such a plan is surprisingly economically, socially, and environmentally beneficial for a city by creating jobs, reducing energy costs, reducing carbon footprints, improving infrastructure, and adding potentially billions of dollars of value to the city.

Given these findings, the City of Columbus must create a climate adaptation plan. To accomplish this, we further recommend that Columbus engage all components of the City in this process, and utilize local scientists to gather city and climate data relevant to goal setting and benchmarking progress. It is also recommended that the City's leadership publicly and definitively support a climate adaptation plan to encourage public participation and support. Overall, total commitment to a climate adaptation plan by leadership, city departments, and the public is necessary to successfully create a climate adaptation plan and experience the benefits that such a plan would provide.

Introduction

Over the past decade, the threat of climate change has been constantly increasing as awareness and research about the topic continues. There have been many efforts to engage individuals about climate change in hopes of sparking interest to take action. As the years progress, more and more people are taking action against climate change, and it is extending beyond individuals; cities are now taking action against climate change and helping their citizens to live a more sustainable life.

In 2013, the Sustainability Tools for Assessing and Rating (STAR) Communities launched with the intent of creating a sustainability framework made specifically for cities. One of the overarching topics within the STAR framework is climate change and how cities can combat it. One of the steps STAR proposes is to create a climate adaptation plan to help address a city's climate vulnerabilities. The overall goal for this indicator is to reduce climate vulnerabilities, and the first step in doing so is for a city to create a climate adaptation plan (*STAR Communities Technical Guide*, 2013).

Our initial research into Columbus' Green Memos and STAR climate adaptation plan criteria yielded a common question: could Columbus implement a climate adaptation plan? With the City wanting to continue its mission of becoming a sustainable city, implementing a climate adaptation plan would propel Columbus to the next level. We explored factors that caused other cities to implement a climate adaptation plan and what made their plan work. Based on our research analyzing the political, economic, and eventually social benefits of a climate adaptation plan, we suggest that creating a plan for the City of Columbus is the best course of action.

Main Research

Boston Case Study

Hurricane Sandy hit the City of Boston in late October 2012. Not only was Hurricane Sandy the deadliest hurricane of the 2012 season, it was also the second-most costly hurricane in United States history (Blake, Kimberlain, Berg, Cangialosi, & Beven II, 2013). Boston was reeling from the effects of such a powerful storm days and weeks after Sandy hit. In the following months, Boston was then hit with nor'easter Nemo and three heat waves in the summer of 2013.

The intense weather over the course of 12 months prompted the Mayor of Boston to create the Climate Preparedness Task Force to better assess the City's vulnerabilities in terms of municipal facilities, operations, services, and policies (*Climate Ready Boston: Municipal vulnerability to climate change,* 2013). His staff in City Hall worked closely with local climate scientists as well as other city departments to accurately identify Boston's vulnerabilities, which mostly revolved around the central notion of flooding (*Climate Ready Boston: Municipal vulnerability to climate change,* 2013). Another big vulnerability identified by Boston was increasing heat in the summertime (*Climate Ready Boston: Municipal vulnerability to climate change,* 2013). The City realized that many of Boston's buildings and roads were threatened due to both flooding and heat waves and that something needed to be done to address this issue.

From there, the beginnings of *Climate Ready Boston*, the City's climate adaptation plan, were born. Boston realized that adapting to climate change is crucial to the City's capital planning and there was a dire need to address climate change. The climate adaptation plan, published in October 2013, focused on sea-level rise/flooding and heat waves, but encompasses the following concerns: facilities & capital planning, transportation & water infrastructure,

neighborhoods, and public health & heat (*Climate Ready Boston: Municipal vulnerability to climate change,* 2013). Each of these sections takes a look at how flooding and extreme heat can affect each area of concern and what the City of Boston is planning to do to combat these vulnerabilities.

When creating *Climate Ready Boston*, the City of Boston worked closely not only with departments within the city, but also with many state and federal departments and agencies. The main purpose of collaborating at these different levels of government was to allow for optimal operational coordination and to address major infrastructure needs (*Climate Ready Boston: Municipal vulnerability to climate change,* 2013). It was important for the City to align their short-term plans and their long-term engagement with the government at both the state and federal level to ensure the optimal implementation of *Climate Ready Boston* (*Climate Ready Boston: Municipal vulnerability to climate change,* 2013).

Analyzing the City of Boston and their climate adaptation plan provides a better understanding of the plan and what brought *Climate Ready Boston* to fruition. Having this background knowledge allows for the comparison between Boston and Columbus and helps the City of Columbus to assess whether it should implement a plan similar to Boston, use a similar approach to creating a plan, or go in a completely different direction.

Boston Interview

In our conversation with the Assistant to the Environmental Chief of the City of Boston, Leah Bamberger, leadership was a common theme throughout the interview. Discussing the implementation of *Climate Ready Boston*, Ms. Bamberger provided some tips and pointers to Columbus on how to implement a successful climate adaptation plan. Ms. Bamberger said it would be important for Mayor Coleman to stand behind the plan 100%. Citing the City of

Boston and their Mayor's experience, Ms. Bamberger said that Mayor Coleman should not waiver from the language; if the city creates a climate adaptation plan, Mayor Coleman cannot shy away from the words "climate change." Ms. Bamberger did note that the Mayor of Boston did not use the word "climate" a lot when promoting Boston's climate adaptation plan, but she said there was not a need to since there was already a forcing event with Hurricane Sandy. With Columbus, Ms. Bamberger mentioned that the City might place more emphasis on the word "climate" since there is no single driving force behind a potential climate adaptation plan.

The Rockefeller Foundation

The Rockefeller Foundation is a high profile organization that currently funds the work of 33 cities to create climate adaptation plans. The most common denominator of cities that have received Rockefeller funding is vulnerability to sea-level rise or extreme flooding events, as 27 of the 33 cities meet this qualification (*100 Resilient Cities*, 2014). Sea level rise is an incredible motivating factor for proactive action. It is not difficult to see why sea level rise is so motivating, as the higher water levels can put the communities' existence in jeopardy. Because Columbus is not in danger of sea level rise, Columbus cannot look to most of the Rockefeller funded cities for a blueprint or timeline for the creation of a climate adaptation plan. There are, however, other data sources that can show the need for a climate adaptation plan, even without the looming threat of sea level rise.

Climate Events in Ohio

On September 13th, 2008, Hurricane Ike made landfall in Texas from the Gulf of Mexico. One day later, it had traveled across the United States and passed through Ohio, causing significant damage in Cincinnati, Columbus, and many other communities. The consequences of

this storm were severe and enduring. As a result, over 0.53 billion dollars of damages occurred throughout the state of Ohio, much of it being centralized in Columbus. Additionally, up to a billion dollars in insurance claims were made throughout the state. Many insurance companies, such as Nationwide, State Farm, and Grange reported that Ike was the costliest event in their company's history (Wartenberg & Narcisco, 2008).

Following the storm, however, the damages endured. This led many organizations and interest groups to question the reliability and condition of infrastructure. An article written about the discontent of Ohio citizens revealed that a staggering "2.6 million customers in Ohio lost power, including 700,000 AEP customers in central and southwestern Ohio" (Gearino, 2008). This included both residences and some businesses. The true issue with this event, however, was the time it took to recover from the damages. Consumer groups created a petition calling for an investigation into the state's infrastructure and stated that "the scope and duration of the September power failures exceed what can be explained by weather alone" (Gearino, 2008). Even a week after Hurricane Ike hit Ohio, over 77,000 homes and businesses in Columbus were still without power. These power outages sparked protests in some Ohio communities as the frustration over infrastructure failures grew (NBC Associated Press, 2008). This discontent with the infrastructure and poor recovery rate indicates that the city of Columbus is not prepared for these large-scale climate events.

Although Hurricane Ike was a large and devastating climate event, it is not the only one to affect the city of Columbus and Ohio. In 2007, a hailstorm hit the city of Akron in northeastern Ohio. This storm caused over 30 million dollars in damages (Wartenberg & Narcisco, 2008). These types of climate events are continuing to cause millions of dollars of damages to many communities throughout the state of Ohio. This past winter, Columbus, along

with the whole state of Ohio, felt the effects of the polar vortex winter storm with temperatures dropping to record lows. The first of several polar vortex weather phenomena caused up to 124.4 million dollars of damages and resulted in thousands of insurance claims. Some communities reported a depletion of funding and resources for snow and ice removal (Williams, 2014). Authorities reported that at least two deaths resulted from the intense wintery conditions (Weather Associated Press, 2014).

These climate events are not isolated incidents. In a report released by the National Oceanic Atmospheric Administration, data were collected regarding climate events resulting in billion-dollar damages (see Figure 2).

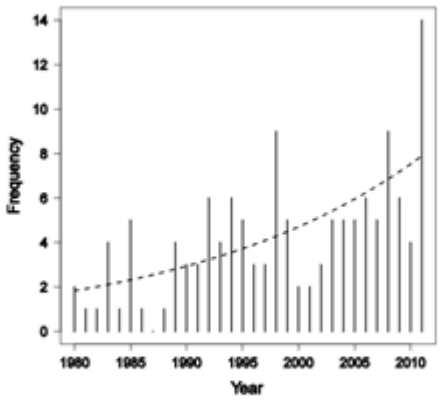

Fig. 2 Time series of annual frequency of billion dollar disasters (vertical bars), along with trend (dashed line) fitted by Poisson regression

The data collected indicated a significant increase in the frequency of billion-dollar climate events and established that there is little probability that there will be any decrease in frequency (Smith & Katz, 2013). These data established the reality that these climate events are going to be a continuing issue that the city of Columbus will have to face. The fortunate thing, however, is that the city has a choice: adopt a responsive mindset and prepare for substantial damages and costs to the city, or adopt a proactive mindset and adapt infrastructure and culture to mitigate and reduce vulnerabilities to these climate events.

Climate Change Data

As there continues to be an increase in climate events, there is an increase in temperature and precipitation trends as well. The United States Geological Survey recently released an interactive data map that shows 39 different climate models for each county in the United States that range from monthly to annual data, covering the mean maximum temperature change, mean minimum temperature change, and mean daily precipitation change (*NEX-DCP30 viewer,* 2014). Changes in temperature and precipitation are measured relative to a baseline of 1980-2004 data and are projected out into the future through 2050-2074.

The climate change data for Franklin County predict that the annual mean maximum temperature will increase by 6.6°F, the mean minimum temperature will increase by 6.3°F, and there will be an increase on average of precipitation of 0.8 inches/day (*NEX-DCP30 viewer,* 2014). The data were then broken down by fall/winter months (October-March) and spring/summer months (April-September). In fall/winter months, the mean maximum temperature will increase by 5.76°F, the mean minimum temperature will increase by 6.44°F, and the increase in daily precipitation is predicted to be 1.13 inches/day (*NEX-DCP30 viewer,* 2014). For spring/summer months, the mean maximum temperature will increase by 7.11°F, the mean minimum temperature will increase by 6.32°F, and daily precipitation will increase by 0.33 inches/day (*NEX-DCP30 viewer,* 2014).

In comparing Columbus' climate change data with the Rockefeller cities Philadelphia, Boston, and Chicago (the leading Midwest climate adaptation city), there are some similarities. As noted earlier, a majority of the Rockefeller cities are either coastal cities or are prone to flooding, making them already geologically different than Columbus, but a handful of cities share similar climate change predictions. While Columbus has different climate projections

than cities on the west coast and in the south, Columbus does have a climate change outlook similar to New York City and Boulder, Colorado (*NEX-DCP30 viewer,* 2014). Compared to Chicago, Boston, and Philadelphia, Columbus matched up fairly evenly with Chicago and Boston (*NEX-DCP30 viewer,* 2014). While a lot of these cities are more prone to flooding than Columbus, a City like Chicago, which has an established climate adaptation plan, helps make the case for a climate adaptation plan because of its similar temperature/precipitation patterns, its location in the Midwest, and its more familiar flooding regime.

While climate change remains a politically charged topic in the United States, the tide is changing in Columbus. A study was done by Yale University to examine the mindset of citizens across the United States in regards to climate change. After surveying 700 adults (18 and older) in the summer of 2013, Yale found that 70% of Columbus residents believe in climate change (Leiserowitz, Feinberg, Howe, & Rosenthal, 2013). Not only do a majority of the local residents believe in climate change, but also 57% of residents want the local government to do something about climate change (Leiserowitz, Feinberg, Howe, & Rosenthal, 2013). This suggests a good deal of potential support in Columbus for a climate adaptation plan.

Michigan's Climate Action Efforts

Research into active climate adaptation plans in the United States reveals that the state of Michigan established a Climate Action Panel in 2007 and released a climate adaptation plan in 2009 for the state. The planning council conducted a detailed cost-benefit analysis of the proposed climate adaptation plan and looked into the social, economic, and environmental benefits such a plan would contribute to the state. The document establishes the fact of human-induced climate change and expresses concern about negative impacts and potential damages to

the state. The document then discusses the focus of the action plan: reduce emissions and diversify energy production. The action plan received a majority or unanimous support level for all policy recommendations and components (Michigan Climate Action Council, 2009).

The Michigan Climate Action Council and the action plan they produced illustrates a number of factors that would provide substantial economic benefits to the state. The document quickly establishes that the policy recommendations would generate a net cumulative savings of approximately 10 billion dollars between 2009 and 2025. Additionally, data indicate that there would be employment gains of over 129,000 by 2025 (the majority of jobs created would be in the development, manufacturing, and operation of wind and solar energy facilities), a gross regional product gain of 8.35 billion dollars by 2025, and an added value to the state exceeding 25 billion dollars. Along with these substantial gains from the climate adaptation plan, it was also anticipated that energy costs would decrease overall due to the diversified energy market and a significant reduction in damages from climate events (Michigan Climate Action Council, 2009).

The implementation of the climate adaptation plan would reduce externalities from various social impacts. Reducing greenhouse gas emissions will increase overall air quality, which will improve public health and should reduce overall medical costs related to lung disease. With communities updating infrastructure and services to be adaptable in the face of changing climate, the public will also benefit from these upgrades. Reduction in road-care costs, more reliable energy, secured business shipping and trading channels, secured fresh-water sources, and improved waste management will all increase standard of living while freeing taxpayer dollars to be used for continued development.

With the plan focusing on reducing greenhouse gas emissions, substantial environmental benefits are expected. Greenhouse gas emissions would achieve an 80% reduction but the attainment of the goals would also reduce the likelihood and severity and potential future climate events. Another environmental benefit is the improved quality of ecosystems with the reduction of air, water, and land pollutants. This will increase the natural capital of the state and increase the value of state and natural parks. This would also help preserve wildlife and biodiversity within the state, further securing resources and a stable environment.

The Climate adaptation plan established by the Michigan Climate Action Council calculated costs and benefits specific to the state of Michigan, and there are significant differences between Columbus and the state of Michigan including climate, financial and natural resources, infrastructure, political climate, and climate vulnerabilities. However, these differences do not hinder a transfer of strategies to create similar results. Although it is not the goal to create a statewide climate adaptation plan for Ohio, the policy recommendations, strategic plans, and expected results are still relevant as many can be adapted to a city level to achieve similar benefits.

Broward County

Erin Miller asked our research team to look into what should be included in a climate adaptation plan. To answer this question, our team looked to the STAR guide. On STAR's website one can look at the scores earned by all the reporting cities. In addition, one can filter the results by individual categories and by the points obtained in each category. Using this method, we identified Broward County Florida as the area receiving the most points in climate adaptation (*STAR Communities Technical Guide,* 2013). We decided to take a closer look at Broward's

climate adaptation plan and the results were very surprising. First, the report is labeled "Climate Change Action Plan" and with this title comes a wide range of topics. The plan addresses policy and coordination, natural and urban landscapes, infrastructure master planning, water resources, modeling-monitoring and mapping, zoning and building codes, mass transit/vehicle miles travelled, renewable and alternative energy, recycling/zero waste, marketing and incentives, outreach and communications (*Broward County Climate Change Action Plan,* 2013). The list of topics covered in Broward's climate change action plan is extensive, and includes a wide variety of sustainability topics. Another interesting aspect to note is that in appendix C of the document, labeled "climate change task force members, subcommittee members and contributing county staff," approximately 215 individuals are named as contributors in the creation of the plan. What our investigation into Broward County's plan revealed is that the STAR rating system does not provide clear guidelines for the scope of a climate adaptation plan. Broward County is receiving nearly twice the amount of points in the category of climate adaptation as the 2nd place city, Austin, Texas. Our interviews with leading sustainability cities and our examination of Broward County, STAR's leading city, showed great variability in the scope of climate adaption plans.

Engaging a Local Climate Scientist

During interviews with cities that are leading the way on climate adaptation plans, the best practice of obtaining local climate data was often emphasized. The leading cities explained that obtaining local climate data is a crucial and foundational step upon which all further steps are built. Current climate projection models produce predictions that are accurate over a large geographic region or state. Local climate scientists are able to scale down these large-scale models to obtain climate projections that are city specific and therefore accurate to a much

higher degree. Why is this step important? For example, imagine that the city would like to identify areas within Columbus that are predicted to experience heat waves and to also identify areas that are vulnerable to power outages or have an inability to cope with increased heat. After both steps have been taken, the city can then identify areas that are both projected to experience heat waves and have an inability to cope with the increased heat. An area that meets both qualifications would be an area of high concern. So again, why is local climate data important? This example illustrates that climate projections that are accurate on smaller scale will allow for high concern areas to be identified with much greater confidence than if a city uses data meant for a state or larger geographic area.

To obtain this smaller scale climate data Columbus should engage a local climate scientist. When looking at best practices, some cities have paid climate scientists while other cities have engaged their local climate scientist early in the process and have received climate data pro bono. A common trait of cities that obtain the climate data for free is that they often are well connected to the local university that houses a leading climate scientist. It is well known that Columbus and The Ohio State University share strong ties. We therefore identify engaging a local climate scientist at Ohio State as an important step in Columbus's creation of a climate adaptation plan.

Identifying Vulnerabilities

To determine how Columbus should go about identifying the city's vulnerabilities, we first looked through the current best practice literature. The literature often focused on the use of matrices that used color-coding based on the degree of vulnerability and the likelihood of the event happening. Many cities create their own matrix with a different look and feel (See figure

3). These matrices effectively serve to convey a topic that is complex and involves a lot of uncertainty, and presents it in a way that is visually appealing.

Although these matrices seem popular, some cities are turning to alternative methods. In an interview with Sarah Wu, City of Philadelphia's Policy and Outreach Manager in the Mayor's Office of Sustainability, Wu said she was initially drawn towards using a vulnerability matrix. However, as she attempted to assess the vulnerability among the different departments of the Philadelphia government, she recognized that the matrix was something better in theory than in practice. Instead, she and her team used a strategy that she describes as simply having conversations. This involves sitting down with members of each department individually and presenting them with different climate scenarios. These scenarios are presented as the potential work environment that the department could face in the future. What follows is a conversation about how the climate scenario will affect a department's ability to do its daily jobs. Homework must be done by the Green Team to determine the level of understanding regarding climate change in each department. If climate change is a topic that a department has had very little exposure to, then the Green Team will need to be able to establish baseline understanding. After the departments have been introduced to the topic and a baseline understanding has been established, the Green Team

		Risk				
		1 Near Impossible	2 Unlikely	3 Notable Chance	4 Likely	5 Almost Certain
Severity	1 Insignificant	1	2	3	4	5
	2 Minor Injuries	2	4	6	8	10
	3 Notable Injuries	3	6	9	12	15
	4 Major Injuries	4	8	12	16	20
	5 Death	5	10	15	20	25

Figure 3: New York Risk vs. Severity Matrix

will present the city-specific climate data. This approach tends to be less theoretical and more practical. Wu says that it is important to note that some departments will voice the concern that their department's budget is already stressed and that they have been applying "Band-Aid" solutions to their problems for years. Wu makes it a point to tell the departments that getting proactive about vulnerability assessment can be a way to finally get ahead of the curve, so that solutions can be in place before the problems arise and tend to put so much strain on budgets.

Acknowledging Climate Change

The final question that we sought to answer is: is it necessary to use the word "climate change" or can "emergency preparedness" accomplish all of the goals of a climate adaptation plan, without the politics and emotion attached to climate change? Our research suggests conflicting advice. On the one hand, an emergency preparedness plan can speed up the process of making citizens safer through planning. On the other hand, not addressing climate change seems strange coming from an organization labeled "The Mayor's Green Team." On the whole, our interviewees suggested that an emergency preparedness plan is an effective way to make your citizens safer, but our interviewees recommended that cities still aim for a climate adaptation plan. Sara Wu expressed this best, saying that climate adaptation plans seek to offer mitigation and adaptation to climate change. This goal requires the changing of city-wide processes and in some cases involves changing attitudes. Because the city is calling for change it is necessary for the city to adequately address the motivation behind the changes, and this involves openly stating that climate change is driving the need for change. This suggests that an emergency preparedness plan and a climate adaptation plan should be thought of as a two-tiered system. In the first tier of emergency preparedness, a city develops ways to adapt to climate

change and by doing so, reduces vulnerabilities. An emergency preparedness plan can realistically be accomplished without the mention of climate change. The next tier is a climate adaptation plan, which can build off of an emergency preparedness plan or stand alone. A climate adaptation plan is ideally proposing solutions that offer both mitigation and adaptation (see figure 4). Because this is a more ambitious goal, the citizens should be made fully aware of the motivating force, climate change, and the city's goals of being proactive.

Recommendations

Based on the data collected, we recommend the city of Columbus create a Climate Adaptation Plan and follow these steps:

1. **Strong Leadership:** Full support from the Mayor is essential. One key lesson learned

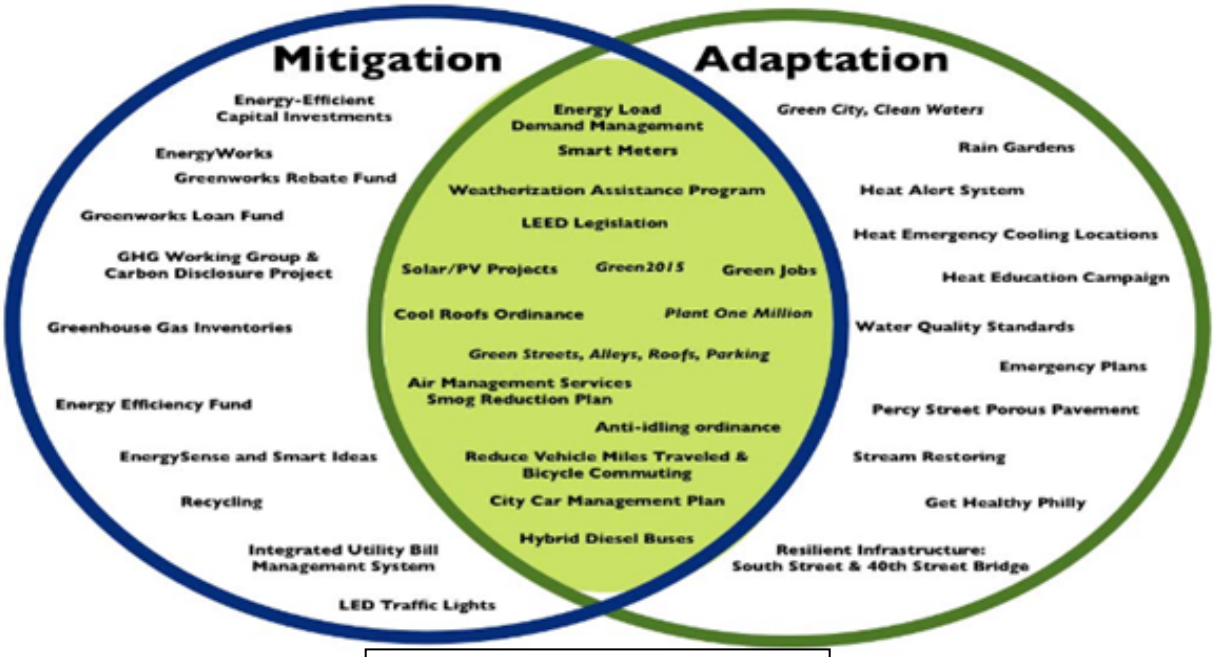

Figure 4: Mitigation vs. Adaption Venn Diagram

during research into other city climate adaptation plans is the need for a supportive leadership foundation. Without leadership support, the public will have difficulty understanding the importance of the creation and implementation of a climate adaptation plan and the plan may not

come to fruition. Also, consistent language when regarding climate issues and the action plan are also fundamental, such as using 'climate change.' This consistent language will not only assist the public with understanding the work being done on the subject, it also contribute to the overall cohesion among partners in the effort.

2. **Engage City departments and organizations:** The creation and implementation of a climate adaptation plan is a large and diverse effort. The City of Columbus has many potential vulnerabilities and only the departments that have these vulnerabilities know how to best manage and improve adaptability given the department's structure and resources. To optimize the effectiveness of the climate adaptation plan, the City (potentially the Mayor's Green Team) will need to reach out to all affected city departments in an on-going process to identify vulnerabilities and benchmark improvements in reducing them. All relevant branches of the city need to understand the importance of this effort and know the reasons why this needs to occur and the benefits that will be gained from a climate adaptation plan.

3. **The involvement of climate scientists is essential:** To support the efforts of creating a climate adaptation plan, research will need to be the foundation. Preliminary research regarding basic climate change in the area and public opinion on the matter has already been conducted, but a great deal more research is required to adequately reveal the severity of vulnerabilities and potential for development. This will include research into the current and future climate conditions of the city, water systems, commercial and residential energy usage in the city, energy sources, infrastructure reliability, and many other areas. All of this data must then be used to create a comprehensive report that the city and the public can understand and refer to as adaptation efforts begin to create change. From these data, realistic goals for the city can be set along with potential strategies to inspire the city and give Columbus something to work towards.

4. **Dedication from the entire city:** A Climate Adaption Plan will require dedicated individuals and teams, a substantial amount of time and financial resources, and leadership support. Although the concept may be intimidating, the economic, social, and environmental benefits produced by developing and operating a climate adaptation plan significantly outweigh the initial and continuing costs of such a plan. The end result of dedication to a climate adaptation plan is a city that is resistant to and recovers quickly from climate events, a city that is a secure and healthy place to live, a city that is conscious about its global impact and carbon footprint, and a city that is a global leader. The creation and implementation of a climate adaptation plan will earn significant points for STAR, although earning these should not be the main reason for pursuing such a plan. A climate adaptation plan is an economically feasible and logical next step for the City of Columbus.

Conclusion

In reality, climate change will continue to affect our communities and systems into the distant future. With this reality comes a threat of great damages, system disruptions, and loss to communities, individuals, businesses, and environments alike. It is inevitable that Columbus, Ohio, will experience these climate events; the city has already experienced a great deal of impacts due to the changing climate. However, Columbus has the opportunity to not only reduce its vulnerabilities to these climate events, but also potentially reduce the severity of these climate events. Our research indicates that the development of a climate adaptation plan, and its operation, is not only politically possible, but is economically lucrative. The improved infrastructure, added community and economic value, large growth in jobs, and reduction of climate related costs are all economic components that a climate adaptation plan offers while drastically offsetting the costs of a plan. We recommend that the City of Columbus develop a

climate adaptation plan as it is a logical investment that will enhance the economy and improve the city overall for all the businesses and residents who call Columbus home.

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Appendices

Dataset #1: climate_change_data.xlsx
Sources: USGS website: http://www.usgs.gov/climate_landuse/clu_rd/apps/nex-dcp30_viewer.asp
Description: This dataset includes information on climate change data for 16 counties including: annual mean maximum and minimum temperature change, annual mean precipitation change, mean maximum and minimum temperature change from October-March and April-September, and mean precipitation change from October-March and April-September. This data was used in the climate change data section of the paper.

Dataset #2: boston_interview.docx
Source: Leah Bamberger, Assistant to the Environmental Chief, City of Boston
Email: leah.bamberger@boston.gov
Description: Notes from conversation with Leah Bamberger regarding the implementation of *Climate Ready Boston*. Phone was on February 6, 2014. Questions included:

1. Was there any forcing events that helped get the climate preparedness plan going? Or was it just subtle build up from interest groups?

2. Did Boston face any opposition when the plan was announced?

3. What were some of the biggest obstacles faced when working on the climate preparedness plan?

4. Did Boston integrate their emergency preparedness plan with the climate preparedness plan at all?